Bay Area High-Occupancy/Toll (HOT) Network Study

Final Report

Conducted by
Metropolitan Transportation Commission
in cooperation with Caltrans

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1. Introduction

High-occupancy/toll (HOT) lanes are a proven concept based on well-established technologies. Individual HOT lane corridors have operated effectively in southern California since the mid-1990s. Based on experience in Southern California and national trends, the California Performance Review conducted in 2005 recognized HOT lanes as a useful tool to address the state's mobility and infrastructure challenges. Four HOT lane corridor demonstration projects are scheduled to open in the Bay Area by 2013 under existing state legislative authority. The first of these will open on I-680 over the Sunol Grade in 2010. The other demonstration corridors include: I-580 eastbound through the Tri-Valley, and US 101 and State Route 85 in Santa Clara County. A number of other cities in the US have recently opened HOT lane facilities or plan to do so in the next five years.

This study advances the HOT lanes concept a step to examine the feasibility of creating a complete regional network level of HOT lanes in the Bay Area, as called for in the regional long-range transportation plan *Transportation 2030*. The system would be developed by converting the region's extensive existing high-occupancy vehicle (HOV) lanes to HOT lanes and closing gaps and extending the HOV/HOT system where possible. A complete regional network, as opposed to a series of individual corridors, has powerful potential to serve travelers, reduce congestion and reduce vehicle emissions at a regional scale. Objectives for the regional HOT network are listed at right.

Bay Area HOT Network Objectives

1. Ensure efficient operation of an expanded HOV network that provides a safe and reliable travel option for express buses and carpools. HOT lanes can be implemented in a way that ensures priority for buses and carpools today and into the future. A regional network of HOT lanes could provide funding to complete the priority network decades sooner than would be possible using traditional state and federal funding sources.
2. Improve the efficiency of the freeway system by reducing person-hours of delay and vehicle-hours of delay.
3. Offer congestion insurance. Studies show travelers from all income groups and professions value having a reliable travel option for those times when they most need it.
4. Make HOT lanes and their benefits, including improved reliability and reduced travel time, accessible to all impacted travelers.

This first-order analysis suggests the region's HOV system can incorporate HOT lane functions and continue to offer priority for carpoolers and express buses, while improving overall freeway efficiency. Further, the Bay Area HOT network could be delivered by 2025 and could be self-financing over a 30-year period if developed and financed as a regional system rather than a corridor-by-corridor endeavor. Current state law does not, however, provide a governance framework for a truly regional network. Further discussions with state, regional and local stakeholders are necessary to define a workable governance structure.

This feasibility assessment should be viewed as a first step toward delivering a regional HOT network. In addition to assessing general financial feasibility, the study proposes a phased

implementation plan, reviews travel and air quality benefits and identifies policy and governance considerations. As such it lays the groundwork for subsequent, more detailed analyses needed to address both technical and policy matters.

2. Summary of Preliminary Findings

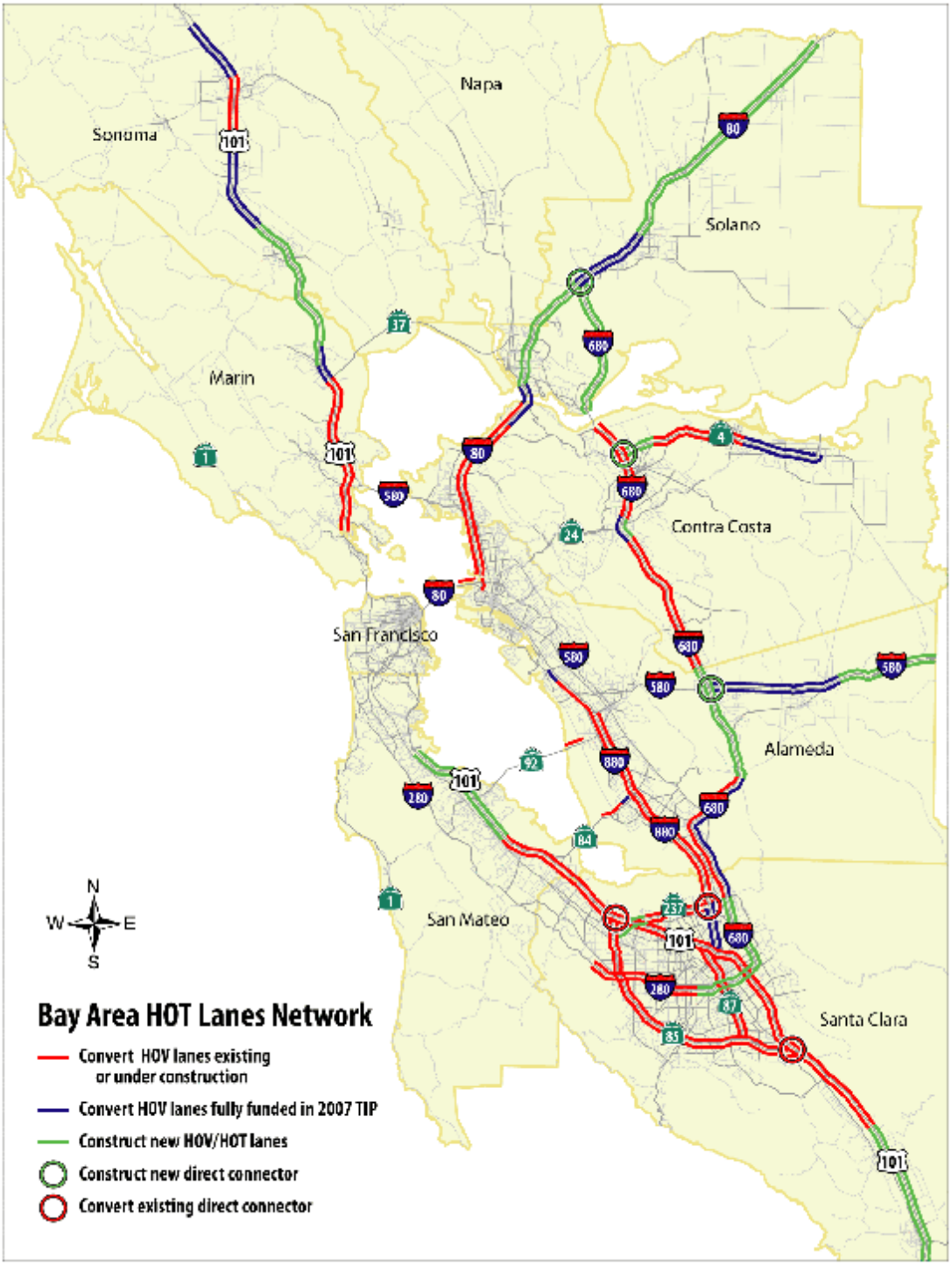
The region's HOV system can incorporate HOT lane functions and continue to offer priority for carpoolers and express buses. As recent federal and state reviews show, California's HOV system will need to be managed to preserve timesavings as carpooling grows over time. A variety of strategies from increased enforcement to integrated corridor management can help HOV lanes operate more effectively as they become crowded over time and forestall more involved measures such as increasing carpool vehicle occupancy requirements or adding a second lane through dynamic lane management or widening, where possible. Even without introducing HOT lanes, carpool volumes in approximately six of the region's HOV corridors are projected to grow the point of crowding over significant distances between 2020 and 2030. Conditions are projected to become crowded in another nine HOV corridors between 2030 and 2040. When steps such as increasing carpool occupancy requirements or adding a second lane become necessary, HOT lanes can be introduced as a tool to ensure freeway capacity is used efficiently and to manage continuing operation.

A regional network of HOT lanes completed by 2025 can pay for itself over 30 years. Based on conservative cost and revenue estimates and a conservative approach to financing, revenues should be sufficient to cover operations costs and guarantee bond financing for conversion of existing HOV lanes and construction of gap closures and extensions to complete the network. (See Bay Area HOT Network Map, next page.)

The HOT network that operates full time or close to full time could generate net revenue to fund complementary transportation improvements while sustaining a high level of borrowing. Developing the network by 2025 requires several years of major capital outlays; the borrowing need is approximately $4.7 billion and requires 30-year financing to cover capital costs. However, revenue growth is robust in later years, and the network would generate positive cash flow, even accounting for financing costs, prior to 2030. Over 20 years, the regional network could generate net revenue up to $3 billion, after accounting for debt service payments. Restricting HOT lane operation to the most congested peak periods would likely dampen revenue generation to a point that would not sustain the borrowing required to deliver the complete network by 2025.

Because the HOT network generates a revenue stream that permits bond financing, the network can be completed much more quickly than if developed using traditional funding sources. This itself offers benefits in the form of travel timesavings. **By more efficiently using freeway capacity and thereby reducing congestion, HOT lanes can reduce the cumulative amount of driving time for drivers in the regular, general-purpose lanes as well as those who choose to pay the toll for a faster, more reliable trip.** Preliminary analysis suggests the regional HOT network could reduce the amount of freeway driving time (measured in vehicle hours) in the morning peak period by 21 percent in the adjacent general-purpose lanes. Further, by maintaining level of service standards in existing state law, average travel speeds of 54 miles per hour could be maintained in the HOT lane.

Bay Area HOT Network



Even if the HOT network were merely to break even in the first 30 years, the region would gain tremendously by developing the HOT network. **Revenue from the HOT network would free up for other investments a total $2.6 billion (2006$) that would otherwise be spent to expand the HOV system.** Of this, nearly $1 billion is in region's current long-range transportation plan, *Transportation 2030*, and the remainder lies beyond the plans financial capacity.

It is critical to approach Bay Area HOV and HOT lanes from the perspective of a regional network. Tremendous benefits can accrue from a connected system. A 2003 performance audit of the Los Angeles HOV system found that fully two-thirds of the travel benefits are lost at gaps in the system where HOV traffic is forced to merge into remaining travel lanes.[1] From a financing and deliverability standpoint, too, the complete system can be achieved only by considering a network as a whole. Pooling revenues significantly increases bonding capacity and makes it possible to finance development of some corridors that are unlikely to generate the level of revenue required to be financeable on their own. Prior to 2030, most corridors essentially break even (i.e., their revenues cover their costs) and just a few corridors generate net revenue on the order required to secure the bonds. After 2030, a number of corridors begin to generate significant net revenues.

A governance structure must be put in place to deliver a regional HOT network. The governance structure needs to facilitate the development and operation of a network that provides a seamless experience for travelers while balancing state, regional and local interests. The current statutory framework approaches HOT lanes on a corridor-by-corridor basis and likely is not adequate to address the considerations involved in implementing a regional network.

3. Bay Area HOT Network Overview

The Network

The Bay Area's existing HOV system comprises approximately 350 miles of HOV lanes. Another 140 miles are currently under construction or fully funded and expected to open before 2015. The regional HOT network would be developed first by converting to HOT lanes the HOV lanes in place by 2015 and subsequently constructing direct connectors and approximately 300 miles of new HOT lanes to close gaps and extend the system. (See Bay Area HOT Network map.) The network considered in this study would ultimately provide priority lanes on nearly 800 of the region's 1,200 directional miles of freeway.

Admittedly, this network leaves two considerable gaps in the HOV network where environmental, structural and traffic considerations pose exceptional challenges. One gap lies on the U.S. 101 corridor between San Francisco International Airport and San Francisco. A second lies on the I-880 corridor between the Oakland International Airport and the Bay Bridge approach. These segments are being evaluated in separate corridor studies.

Design

Weave Lane

The design anticipated for the regional HOT network is similar in concept to that in place in Minneapolis, as shown next page. A single HOT lane in each direction would be separated from its adjacent travel lanes by a painted double yellow stripes and four-foot buffer. In contrast to the existing, continuous access HOV lanes in the Bay Area, drivers would be able to enter and exit the lanes only at designated locations. This study assumes weave lanes to facilitate merging at those locations. (See example of weave lane, right.) The limited access design is a

[1] Los Angeles County Metropolitan Transportation Authority. HOV Performance Program Evaluation Report (November 22, 2002).

Minneapolis I-394 HOT Lane

function of current electronic toll collection technologies, which use roadside toll readers to collect tolls based on use of the HOT lane.

Tolls

As with existing carpool lanes, qualifying carpool and buses would use the lanes for free. Other vehicles would pay tolls collected using FasTrak® toll technology. Tolls would vary with traffic congestion, rising as traffic increases (in effect charging more when the HOT lane offers more travel time savings). To maintain priority for carpools and express buses, tolls would be set so the HOT lane operates at level of service C conditions or better, as required by current law. As traffic approaches the threshold, high toll rates would discourage tolled vehicles from entering the lane. Qualifying carpools and buses would always have priority access over toll-paying vehicles at no charge. Advance signage would allow other drivers to decide whether they want to enter the HOT lane given the toll rate in effect at the time. Travelers would typically pay 20 to 60 cents per mile in 2015 and 50 cents to $1 per mile in 2030 to bypass peak period traffic congestion (2006$). As space becomes very scarce in some corridors, posted toll rates may be higher to prevent the HOT lanes from becoming over crowded.

Enforcement

Revenues from the HOT lanes would be used to fund expanded enforcement by the California Highway Patrol (CHP). CHP officers would enforce both toll violations and HOV occupancy requirements. Technology is available identify vehicles that do not pay tolls. Currently, no technology exists to aid CHP officers in verifying vehicle occupancy, and visual verification is likely to be necessary at least in the near-term.

4. HOT Network Phasing

This study outlines a phasing plan to develop the regional HOT network by 2025. (See Bay Area HOT Network Phased Implementation maps, next page.) The four existing HOT lane demonstration projects will be in operation by 2015 and comprise the first pieces of the regional HOT network. Following this, the general strategy is to begin by converting to HOT those HOV lanes in place in 2015. As a second step, new HOT lanes would be constructed to close gaps. System extensions would tend to be the last pieces developed. A focused program management effort for project development, environmental and design would likely be required to undertake this effort.

A number of other important factors are considered in combination with the general strategy. These include: travel time savings and revenue generation, which will be highly correlated; benefits for HOT lane and transit operations; geographic balance so that portions of the region are not left behind for long periods of time; and consideration of actions needed to preserve HOV lane functionality, which is discussed further below. Project development and construction time requirements are also a consideration. Under current Caltrans protocols, project development and environmental process might take up to five years for segments where existing HOV lanes are converted to HOT lanes and closer to ten years for segments where new lanes must be constructed.

Bay Area HOT Network Phased Implementation

While it is important to think of the regional network as a single system, there are five geographic sub-areas (listed below) where sequencing and staging decisions have clear effects on other projects and so provide a framework for a phasing strategy.

Bay Area HOT Network Sub-Area Groupings

Associated with I-680	Santa Clara/ San Mateo	Associated with I-80	Marin/ Sonoma	Associated with I-880
I-680 SR 4 I-580	US 101 SR 85 SR 87 SR 237 I-280 I-880 [1]	I-80 [2]	US 101	I-880 [3] SR 84 SR 92

[1] SR 237 to US 101 in Santa Clara County
[2] Bay Bridge to Yolo County Line
[3] Oakland to SR 237 in Santa Clara County

HOV Crowding and HOT Implementation

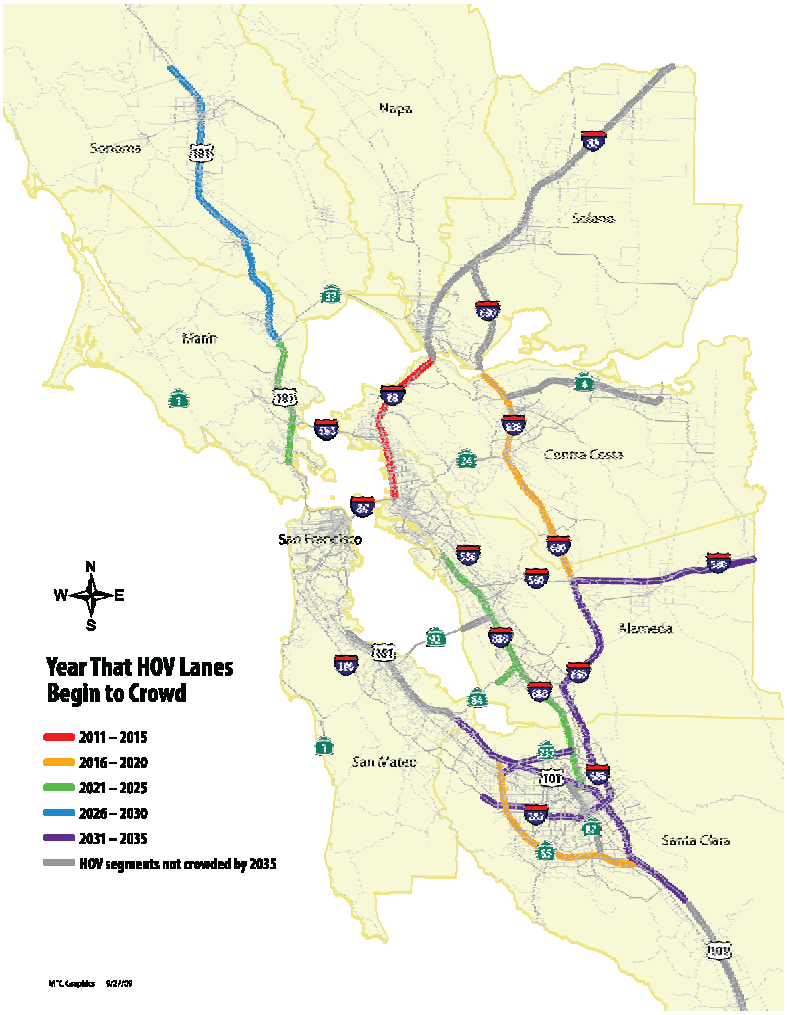
Analysis shows the region's HOV lanes will become increasingly crowded over time and will eventually jeopardize their ability to serve their very purpose – providing travel time advantages and reliable trips for carpools and express buses. Caltrans is currently developing a managed lanes business plan that will outline near-term and longer-term measures to address this concern. Near-term measures, such as better enforcement, incident management and freeway management strategies, can address spot crowding and slow its spread.

With the HOV/HOT Business Plan still under development, this study assumes the longer-term approach to preserve HOV lane function will be to increase carpool occupancy requirements. This is by no means the only solution, but it is likely to be the most cost-effective, longer-term solution in most Bay Area corridors. Other solutions would provide two HOV travel lanes either by widening to add a second HOV or HOT lane or by converting one adjacent general purpose lane to a dynamic dual lane that would operate as an HOV or HOT lane during the most congested periods only. While dual HOT lanes have many operational and safety advantages, this approach is likely to be feasible or cost-effective on a corridor basis in few Bay Area locations; however, it may be possible to create dual lanes in spot locations to alleviate choke points. HOT lanes complement all of these longer-term strategies by ensuring any new or "freed up" capacity created by the new strategy is fully utilized from the start.

In many Bay Area corridors, longer-term solutions will not need to come into play until 2030 or later. (See map next page.) The phasing plan begins HOT lane operations much earlier in many of these corridors under existing carpool occupancy requirements. The lanes can continue to work as HOT lanes as long as carpool occupancy requirements are increased as the lane begins to crowd over significant distances.

In a few corridors, crowding is more imminent. In these corridors, HOT lane operation might be deferred until occupancy requirements need to be increased to preserve carpool and express bus function. This avoids the perception that the objective is to squeeze out carpools to make room for tolled vehicles and avoids offering toll paying customers an option that is only short-lived.

HOV Volumes Grow to the Point of Crowding Over Time



Interstate 80 is a case of particular interest because the HOV lane is already experiencing crowding on a regular basis and is already restricted to carpools carrying three or more people. The HOV lane also serves a high volume of express buses, providing a reliable and fast trip through this top-ranked congested corridor. Conditions call for implementing near-term strategies very soon to preserve the function of this carpool lane. As in other corridors, these strategies will improve HOV lane operations and buy some time; however, a more far-reaching solution will be required in the not-too distant future. Possibilities include: restricting access to vehicles with four or more people or to buses and vanpools only or adding a dynamic dual lane that would operate as an HOV or HOT lane during the most congested periods only. A HOT lane function makes sense in any of these approaches because it ensures the lane or lanes are fully utilized.

5. HOT Network Cost, Revenue and Financing

Study Approach and Methodology Overview

This report reflects work undertaken over 18 months in two initial HOT network study phases that, together, comprise a first-order feasibility analysis and implementation plan. Phase 1 involved an assessment of the feasibility, costs and revenue associated with two distinct Bay Area HOT network configurations: (1) a partial network developed by converting only existing HOV lanes and those fully funded through year 2015; and (2) the complete network proposed in this report. Phase 1 suggested 30-year net revenue from the partial HOT network, if all corridors were converted in 2015, could cover most of the cost to complete the network. Phase 2 expanded the analysis of the complete network, refined cost estimates based on further experience with the I-680 Sunol HOT lane, and developed preliminary implementation and financing plans for phased development of the entire network by 2025.

As appropriate for a first-order assessment of a HOT network of this scale, the initial study phases use simplified, yet conservative, approaches to estimating costs and revenues. Capital

costs are based on a range of unit costs that include contingencies of 40 to 60 percent. Revenue estimates are generated by a tolling model that builds on forecasts from the regional travel demand model. This preliminary analysis does not include, as a more detailed analysis would, feedback between the travel demand and revenue models or consideration of operational constraints. The revenue analysis includes several provisions that make revenue estimates conservative notwithstanding this simplification: (1) revenue is presented in a range where the low-end represents a 30 percent reduction from the toll model forecast; (2) revenue estimates assume a tolling policy that would maximize travel time savings rather than revenue; and, (3) a cautious approach is used to estimate revenue from the evening peak period. (See the appendices to this report for more detail on the study assumptions and methodology.)

Cost

The total capital cost to develop the regional HOT network is $4.8 billion dollars (2006$). This total includes conversion of HOV lanes that exist today and those that are fully funded ($1.4 billion) as well as widening to close gaps and extend the system ($3.4 billion). At the low cost end, converting HOV lanes to HOT lanes involves adding toll tag readers and signs and restriping the roadway. To be conservative, higher per mile costs are assumed in most corridors, to reflect the likely need to add new pavement and right-of-way and, in some corridors, to modify existing structures to achieve a design consistent with Caltrans principles for the I-680 HOT lane demonstration project over the Sunol Grade:

- A single HOT lane in each direction would be separated from the adjacent general purpose lanes by a painted double-striped line and a four-foot buffer;
- Access and ingress locations would be separate and would include a weaving lane to allow traffic to transition between the faster HOT lane and slower adjacent lanes; and
- Space would be provided in the median for CHP patrols to provide enforcement.

It would be helpful to explore where modifications of this “ultimate” design protocol would be both operationally viable and less costly.

For segments where HOV lanes do not exist or are not otherwise funded, the capital cost estimate reflects the cost of widening to accommodate an additional travel lane in each direction as well as toll-related equipment and signs. The network cost also includes new, direct HOT lane to HOT lane connectors at major interchanges, including I-80/I-680, I-680/SR 4 and I-680/I-580. The cost estimate does not include direct access ramps or complementary express bus system enhancements, which should be considered among the possible investments for positive net toll revenue.

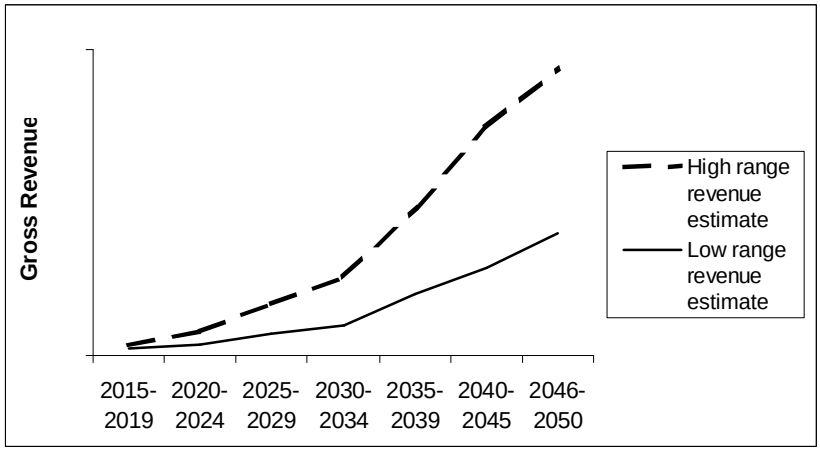
The operating and maintenance cost for the Bay Area HOT network is estimated to total $1.5 billion over 20 years. This includes CHP enforcement, toll equipment maintenance, communications, utilities, administration, FasTrak® toll tags and costs of processing toll transactions. This estimate does not include the cost to maintain the roadway itself. (See discussion below.)

Revenue and Financing

Revenue potential of the Bay Area HOT network depends on four principal factors: tolling policies, congestion levels, carpooling policies and demand, and the willingness of travelers to pay for a faster, more reliable trip.

With the phased plan developed in this study, the regional HOT network could generate between $8 and $11 billion in gross revenue between 2015 and 2035, assuming full time operation (24 hours per day, seven days per week). Analysis suggests revenue would grow steeply in the years beyond 2035, as real income rises (and travelers are willing to pay more for speed and reliability) and congestion levels and the length of congested peak periods grow. (See graph at right.)

Revenue Growth is Robust Over Time



Developing the regional HOT network by 2025 would require 30-year bond financing to cover approximately $4.7 billion in capital outlays. Debt service over 30 years would total $9.4 billion.

With the phased plan from this study, revenues from the HOT network are likely to cover costs over the 20 years between 2015 and 2035. If HOT revenues reach the high end of estimates to date, HOT network revenues could exceed costs, including debt service, by approximately $3.1 billion over that time. If revenues lie at the low end of current estimates, HOT network revenues are approximately equal to costs over the 20-year period.[2] (See table, below.)

HOT Network Cost and Revenues

	2015 to 2035 (billions of 2006$)	
	Low Estimate	**High Estimate**
Gross revenue	$8.0	$11.4
Operations and maintenance cost	-$1.6	-$1.6
Debt service [1]	-$6.7	-$6.7
Net revenue	-$0.3	$3.1

[1] Based on borrowing $4.7 billion over 30-years. Debt service repayment continues through 2045 for a 30-year total of $9.4 billion.

Modest adjustments to the phased plan can be expected to improve the outlook at the low end of the revenue estimate range while refined approaches to costs and revenues will eventually narrow the range over all.

In order to finance and deliver the regional network, it will be necessary to pool revenues and costs. Not surprisingly, some corridors are stronger than others in terms of revenue generation. (See Net Revenue Potential by Corridor table, next page.) The primary factors that affect net revenue generating potential over this period include:

- Extent of widening required to implement the HOT segment (HOT revenue from corridors that do not have an HOV lane that can be converted to HOT must cover costs of a new travel lane);

[2] Given the level of detail in this analysis a net revenue figure of plus or minus $300,000 million over 20 years can be considered breaking even.

- Assumed HOT lane opening date;
- HOV volumes and date at which the carpool occupancy requirement for free passage increases due to growth in HOV volumes; and
- Congestion levels and willingness of travelers to pay for faster, more reliable travel.

While most corridors do break even over the 2015 to 2035 period, revenues from the high generation corridors are needed to ensure favorable financing and operate the network in the early and middle years. Further, a few corridors – especially those that start operation later – may require a longer period of time before revenues cover costs.

Net Revenue Potential by Corridor, 2015 - 2035

Corridor [1]	Year HOT Lane Opens [2]	Year Carpool Occupancy Requirement Increases to 3+
Generates $1 Billion or More in Net Revenue [3]		
I-880 from 98th Ave. to SR 237 and northbound Bay Bridge approach	2015/2020	2025
I-680 from SR 84 to Calaveras	2010/2015	2035
US 101 from San Mateo County Line to Cochrane	2015/2025	2035
I-680 from SR 84 to I-80	2020/2025	2030/2040
Covers Costs		
SR 85	2013	2020
I-580	2013/2015	2035
SR 87	2015	2040
I-80 from Bay Bridge to Carquinez Bridge	2015	2015
SR 237	2020/2035	2035
SR 84 westbound Dumbarton Bridge Approach only	2015	2025
I-280	2020/2025	2035
SR 92 westbound San Mateo-Hayward Bridge Approach only	2015	
US 101 Millbrae to Santa Clara County Line	2020/2025	2035
I-80 from Carquinez Bridge to Yolo County line	2015/2020/2025	2040
SR 4 from SR 160 to I-680	2020	2020
Fails to Cover Costs		
US 101 from Windsor River Road to Corte Madera	2025/2030	2025/2030

[1] HOT lane corridors are bi-directional unless noted.

[2] First date indicates opening date for initial section; second date is opening date for later extension, if any.

[3] Each corridor projected to generate at least $1 billion in net revenue.

Impact of Tolling Policies on Revenue

Tolling policies also clearly influence revenue. Variations on tolling policies could affect the revenue outlook as follows:

- Tolling objective. The estimates above assume tolls are set to maximize freeway efficiency (measured by the value of time saved for all freeway users) as opposed to maximizing revenue. This is assumption consistent with a policy objective to improve freeway efficiency and makes revenue projections for this initial analysis more conservative. Policies that maximize revenue have been shown to increase revenue by at least 20 percent. However, these policies also result in higher tolls and lower HOT lane usage.

- Full time versus part-time tolling. Full time HOT network operation (24-hours per day, seven days per week) would represent a significant change in the Bay Area where the carpool lanes currently operate during peak commute hours only. Because HOT lanes more effectively utilize freeway capacity, they can operate very effectively in the shoulder periods as well. Revenue generation during the shoulder periods is not insignificant, reflecting travelers' willingness to pay to bypass congestion in these periods.

  Restricting HOT lane operations to the most congested peak periods only would likely dampen revenue generation to the point that borrowing requirements would need to be reduced. In-depth analysis for the I-680 Sunol corridor suggests that by limiting HOT lane operation to eight peak hours on weekdays and four peak hours on weekends yields 71 percent of the revenue generated by full time operation. Assuming a similar pattern holds for other corridors, the network would fail to cover 20-year costs (including financing) even under high revenue estimates for this study. Thus, developing the regional network might necessitate using a combination of state highway funding sources and bonding or slowing down implementation.

  A less restrictive part time tolling policy that included operation over peak and shoulder periods would have much less significant impacts. By capturing peak and shoulder twelve hours on weekdays and 4 peak hours on weekends, revenue generation is roughly sufficient to cover costs at the high-range estimate.

- Hybrid vehicles. Revenue estimates for this study assume no special treatment for hybrid vehicles. Exempting hybrid vehicles from HOT lane tolls reduces the space available for free vehicles and could reduce revenues by 5 to 40 percent depending on the corridor.

Complementary Investments – Candidates for Net Revenue

While the first call on HOT network revenue should be operating and completing the system, revenue projection trends suggest a Bay Area HOT network will generate positive net revenue over time. The point at which net revenue is available for other investments depends both on tolling policies and financing terms. When the time comes, it will be important to make careful trade-offs between potential investments. The discussion among key stakeholders will need to consider regional and state transportation goals and policies, overall investment needs, and notions of equity. Some potential investments include:

- § Express transit. Many regions use HOT lane revenue to provide enhanced express bus service, which both increases the number of people carried during peak periods and extends the benefits of the HOT lane directly to those who may not be able to pay the toll. The 20-year cost (2015 – 2035) for a full complement of enhancements to regional express bus service in HOT network corridors could reach $3.4 billion, though significant benefits could likely be achieved by implementing selected elements.[3] The time at which net revenue is available for expenditure is particularly significant when considering express bus services because toll revenue is likely the only funding resource available for funding operation of significant service enhancements.

- § Roadway maintenance. Caltrans asked that the roadway maintenance costs of the HOT network be enumerated as part of this analysis. Using HOT network toll revenue to fund roadway maintenance would be a departure from current policy, under which the state funds roadway maintenance for state-owned roadways, including the existing HOT lanes in San Diego and Orange County toll roads. It is also true that those paying to use the HOT lanes will expect a high ride quality for their trip. The estimated 20-year cost (2015 – 2035) to maintain the HOT network roadway, including existing HOV lanes that are converted to HOT lanes, is $1.2 billion.

- § Other mobility investments. While HOT lanes are important tool, other investments also will be needed to manage delay and improve mobility in each HOT corridor. These investments are identified in the *Transportation 2030 Plan* and could include ramp metering, auxiliary lanes and other freeway operational improvements, interchange improvements, and rail transit extensions and upgrades. HOT lanes would work in tandem with such improvements.

6. Traffic and Air Quality Benefits

Findings from this analysis are consistent with before and after studies showing HOT lanes improve overall traffic conditions by increasing travel speeds and vehicle throughput, while only modestly slowing travel for carpools and buses. The preliminary forecasts from this analysis suggest that, with build out of the regional HOT network, average travel speeds in 2035 could reach 39 miles per hour in the general purpose lanes during the AM peak period while maintaining average speeds in the range of 54 miles per hour in the HOT lane, consistent with level of service C operating standards. This sounds relatively unimpressive until compared with a system of HOV lanes over the same facilities for which forecasts show substantially reduced speeds in the general purpose lanes (32 miles per hour) but only modestly higher speeds in the HOV lane (56 miles per hour). Similarly, the regional HOT network could reduce total vehicle hours of travel during the morning peak hour by up to 13 percent compared to an HOV only network on the same freeway facilities. (See Traffic Characteristics table next page.)

Because HOT lanes reduce congestion and increase travel speeds, they reduce vehicle tailpipe emissions. In particular, preliminary analysis suggests that compared to a regional HOV network, a regional HOT network could reduce carbon dioxide emissions in the morning peak period by about seven percent. (See Emissions table next page.)

[3] Based on cost estimates for the express bus portion of the HOT/Bus scenario MTC is analyzing in the Transportation 2035 Vision.

Traffic Characteristics of Bay Area HOT Network Compared to HOV Network in Year 2030 [1]

	HOV/HOT Lanes	General Purpose Lanes	Total/ Average All Lanes
AM Peak Hour Vehicle Hours Traveled (VHT)			
HOV network	10,410	120,890	131,290
HOT network	17,960	95,615	113,575
Percent change	73%	-21%	-13%
AM Peak Hour Average Speed (miles per hour) [2]			
HOV network	56	32	34
HOT network	54	39	41
Percent change	-3%	20%	21%

[1] Figures are for freeways with HOV or HOT lanes only and reflect results of analysis assuming existing HOV occupancy requirements for HOV and HOT lanes.
[2] Reflects travel in the peak and reverse peak direction.

Emissions Associated with Bay Area HOT Network Compared to HOV Network in Year 2030 [1]

	Reactive Organic Gasses (ROG) (tons)	Nitrogen Oxide (NOx) (tons)	Particulate Matter (PM 10) (tons) [2]	Carbon Dioxide (CO2) (thousands of tons)
AM Peak Period Emissions - Two peak hours from 7 to 9 AM				
HOV network	2.10	2.18	0.20	4.65
HOT network	2.06	2.11	0.18	4.32
Percent change	-2%	-3%	-10%	-7%

[1] Figures are for emissions on freeways with HOV or HOT lanes only and reflect results of analysis assuming existing HOV occupancy requirements for HOV and HOT lanes.
[2] PM10 emissions reflect exhaust only and do not include tire and brake wear emissions.

It is important to acknowledge this simplified first-order analysis may overstate performance to some degree by not accounting fully for changes travelers might make in response to the improved travel speeds associated with the HOT lanes. For example, travelers who would otherwise choose to drive in the shoulder period might shift into the peak, resulting in somewhat slower travel speeds and potentially higher emissions. However, the comparison above between identical HOV and HOT networks in year 2030 likely understates the true benefits of a HOT network because funding simply is not available to complete the HOV network by that date. Further analysis comparing the regional HOT network and a smaller, less complete HOV system that could be constructed by 2030 likely would show equal or greater performance improvements.

7. Governance and Related Policy Decisions

Governance Structure

A central question for a regional HOT network relates to how it would be governed. Will the regional network be governed through a series of independent tolling authorities, much as the region's transit service is provided today? Or will it be governed through a single multi-jurisdictional authority charged with coordinating and balancing local, regional and state interests?

The framework established under current state law addresses HOT lanes as a corridor by corridor consideration in so far as it: permits limited duration demonstration projects in six corridors in northern California[4]; provides governance structures reflecting corridor interests; and requires net toll revenue to be expended within the corridor of generation. The legislative framework recognizes a few important state and regional roles based on well established roles and responsibilities: design and construction of HOT lanes must be coordinated with Caltrans; CHP will provide enforcement; and the Bay Area Toll Authority will manage and operate the toll collection system. But it does not go far enough in reflecting the full range of coordination required for a regional network.

New legislation will be needed to establish a governance framework to deliver a true connected Bay Area HOT network. The framework will need to recognize a balance between local interests with the strong regional and state roles required to deliver a complete regional network. Local interests are based on the responsibility to deliver benefits to constituents as well as prior investment of sales tax revenue and "county share" state funding in the HOV system and, in the cases of Alameda and Santa Clara counties, demonstration HOT lane corridors. Regional and state roles relate not only to those outlined in current state statute, but also to financing a complete network and operating it in a manner that is seamless and safe for travelers as they move among corridors and across county lines.

Governance arrangements for a regional network exist on a continuum from highly decentralized to highly centralized structures. On the most decentralized end, a series of independent county or corridor tolling authorities would coordinate with each other and regional and state interests through consultations or contractual agreements. On the most centralized end, the state itself would be the tolling authority and would set policy in consultation with local and regional entities. Regional entities empowered under state (SB 45, statues establishing the Bay Area Toll Authority) and federal law (SAFETEA-LU) provide models that lie in the middle of the continuum. In establishing a governance structure the strengths and weakness of each model must be considered in light of the policy decisions to be made and the goals of a regional HOT network.

Related Policy Decisions

Some governance related-questions may be addressed explicitly in revisions to state law that will establish the governance structure. Others will need to be addressed through coordinated decision-making under the established governance structure. The main governance-related responsibilities can be grouped under four main areas.

[4] Current law limits the demonstration projects to four years. AB 574 (Torrico), currently under consideration by the California Legislature, would remove the four-year limit and allow the authorized agencies to operate the HOT lanes indefinitely.

- Costs, revenues and financing. Where a HOT lane can generate significant revenue, its value is apparent to local, regional, and state organizations. With all such jurisdictions having more needs than can be funded from known sources, having a potentially significant on going and growing funding source become available is very significant. Key governance decisions address how HOT lane revenues may be reinvested in the transportation system, what types of investments are eligible, how they will be prioritized, and which entities have jurisdiction over various specific investment choices. The governance system will need to recognize the advantages to be gained by leveraging revenues to finance completion of the system while providing for an equitable way to reinvest revenues in complementary transit services and other roadway improvements within the corridor of origin. This may not result in the transitional county-based "return to source" model that characterizes a majority of transportation and highway funding.

- Tolling policies. This category includes a range of decisions that directly affect revenue, operations, and customer satisfaction. The governance structure must provide for decisions about how tolls will be set, for example tolls may be set to maximize travel time savings or to maximize revenue; procedures for increasing tolls; and how carpools, clean-fuel vehicles and hybrid vehicles will be tolled. The question of how many people must be in a carpool in order to qualify for free passage or reduced toll rates falls into this category. Consistency in tolling policies may be more important for some decisions than others.

- Operations & Design. Decisions in these categories similarly affect revenue and customer satisfaction, and they also have direct bearing on cost and safety. Operations decisions relate to the hours of HOT lane operation and enforcement practices including the level of enforcement provided. Design decisions include separation of the HOT lane from the general-purpose lanes, provisions for ingress and egress and enforcement, need for design exceptions, and signage.

- Private sector role. Private sector roles could vary from simple financing, as presumed in this implementation plan and allowed by current law, to a variety of public private partnership models. The latter could range from an operating concession to private development and/or ownership. The options here are closely tied to state law governing public-private ventures and are not explored in this study.

8. Next Steps

This initial assessment suggests a Bay Area HOT network can accelerate completion of a priority network for carpools and buses and improve freeway efficiency. Further because a HOT network is self-financing, its development could free close to two billion dollars that would otherwise be needed to complete the region's HOV system.

These findings suggest it is worthwhile to pursue the next steps on a path toward developing a regional HOT network. The conservative assumptions, large benefits and projected steep revenue growth curve in this analysis suggest cost may be even less of a constraint and, it may be worthwhile and feasible to deliver the network on an even more accelerated schedule. Further analysis could include an assessment of new project delivery staffing structures and review of design principles, to see if it is possible and beneficial to deliver a complete network before 2025. MTC wishes to pursue this additional analysis.

A general roadmap for advancing the HOT network includes the following next steps, some of which would need to proceed in parallel:

1. Refined analysis. Initial steps would consist of more detailed analysis to refine cost and revenue estimates and review operational concerns. Refining the cost estimates requires a more thorough review of the network's physical design, existing constraints and opportunities for ingress, egress and enforcement locations. Design refinements allow refined demand and revenue forecasts, which in turn permit a more detailed assessment of operations considerations. At each stage, it will be important to reconsider the basic parameters of the phasing and financing plans. A first pass would be more involved than the analysis conducted to date but still fairly general. Some specific areas requiring further review include:

   - Closing identified gaps in the network. The network studied to date leaves two significant gaps in the HOV network in two extremely constrained corridors: (1) the U.S. 101 corridor between San Francisco International Airport and San Francisco and (2) the I-880 corridor between the Oakland International Airport and the Bay Bridge approach. These segments deserve a closer look given the significance of these segments for regional mobility and the projected revenue growth potential for the regional HOT network. An initial assessment should compare the cost, traffic and environmental considerations of two admittedly controversial approaches to close the gap: (1) a low-cost, possibly near-term approach of converting an existing travel lane; and (2) a high-cost, longer-term solution that would likely involve substantially rebuilding these corridors with HOT lanes.

   - Interstate 80. Opportunities for incorporating HOT lanes in the I-80 corridor through Alameda and Contra Costa counties in conjunction with steps to preserve and improve the HOV function and overall traffic flow in the corridor.

   - Toll plaza operations. Assessment of how to integrate HOT lanes at the toll plazas of Bay Area toll bridges. The existing toll plazas are designed to accommodate carpools, that do not pay a toll, and FasTrak® users and cash customers, that pay a uniform rate. Operational analysis will be needed to determine how to accommodate a fourth customer class, those who pay a premium rate to avoid a backup.

   - Interface with other planned improvements. This means putting in place procedures so projects under development do not unwittingly preclude the option to provide a HOT lane in the future. It also means considering the potential traffic impacts of HOT lanes in freeway corridor management planning. Integration with other planned improvements could streamline project development and accelerate implementation of the HOT network.

   Subsequent, even more detailed analysis would be conducted as part of the formal documents required in the Caltrans project development process (project study reports and project initiation documents). MTC and Caltrans are poised to kick off a planning-level review of design and refinements to cost estimates later this year.

2. Review of equity considerations. As refined design, demand and revenue analyses become available, it will be possible to assess the equity implications of the regional HOT network. This assessment will consider the distribution of benefits and impacts relative to geography

and income level. The assessment will also document the benefits and impacts to transit users and carpoolers.

3. Governance. The region and state need to map out a governance structure for the regional HOT network. The governance structure must provide a means to establish a host of policies governing, design, tolling and operations practices, and revenue allocation. Several models are possible. These initial study results provide a sufficient basis to begin a dialogue among key regional and state stakeholders about governance. Participants will need to find a solution that allows regional objectives to be achieved (e.g., completion of a regional network) while respecting consideration of local interests (some degree of equity based on past investment and system use). Governance discussions also should address potential roles for the private sector. Ultimately, legislative action would be required to enable development of a regional network and, most likely, to transition the current authorized corridor demonstration projects into a regional governance structure.

4. Public dialog. A certain degree of public dialog and education about HOT lanes has already begun in conjunction with the Alameda and Santa Clara county demonstration projects. This will ramp up over the next year with advancements in project development, the kick off of I-680 HOT lane marketing and education campaign, and the update of the regional long-range transportation plan. The region should expand and piggyback on these efforts over time in conjunction with the steps described here to advance the regional network. However, the biggest opportunity to engage the public in a broad discussion about a regional network will be when Bay Area residents get their first hands on experience with the opening of the I-680 HOT lane in 2010.

5. Financing. The HOT network financing plan will need to be refined as cost and revenue projections are refined. Potential financiers will require investment grade analyses before underwriting bonds. However, it is probably wise to initiate discussions with potential financiers fairly early to better understand their assessment of risks relative to key governance and policy decisions. For example, financiers will be keenly interested in policies that govern tolling rates, treatment of carpools, and hours of operation. Reducing the uncertainties likely to be seen by financiers may enable the region to use a lower coverage ratio (the ratio between available revenues and the debt repayment amounts).